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2. DEPARTMENT DATA EXPENDITURES FOR THE PURCHASE OF ACADEMIC SCIENTIFIC RESEARCH INSTRUMENTATION

2.1. Summary of Total Expenditures

The total estimated annual expenditures for the purchase of academic scientific research instrumentation in the biological sciences were \$283 million in 1993. This was an increase of 11 percent from the \$256 million that was spent in 1989. (Table 1) This continues the trend of increasing expenditures for the purchase of scientific research instrumentation evidenced since the survey began in 1983, when the expenditures were \$130 million. However, the 3 percent annual rate of increase of expenditures from 1989 to 1993 represents a slower rate than in previous survey cycles. During the period 1986–89, the annual rate of increase was 11 percent, and during 1983–86 it was 12 percent.

Table 1. Trends in annual expenditures for the purchase/acquisition of scientific research instrumentation in the biological sciences, by field of biological science, type of institution, and institutional control: 1983-93

[Dollars in millions]

Field of biological science, type of institution, and institutional control	Survey year			
	1983	1986	1989	1993
All biological sciences	130	185	256	283
Research field:				
Biochemistry.....	19	27	50	33
Cell biology/genetics.....	18	10	15	41
Microbiology	11	20	23	40
Pathology.....	8	13	11	17
Pharmacology.....	13	17	17	10
Physiology/biophysics	16	15	14	27
Other biology, general.....	45	83	127	115
Type of institution:				
Medical schools, total	79	98	137	175
Public	44	60	98	110
Private	35	38	39	65
Colleges and universities, total	51	88	119	108
Public	32	61	84	85
Private	19	26	35	23

NOTE: Because of rounding, details may not add to totals.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

2.1.1. Expenditures by Field of Biological Science

The overall field of biology experienced consistent increases in its expenditures for research instrumentation during the period 1983–93. Except for microbiology, however, the expenditures patterns for the subfields varied considerably, especially during 1989–93. (The expenditures for microbiology increased for all survey cycles.) In some of the subfields, the expenditure pattern for research instrumentation varied between each survey but increased significantly during 1989–93. For example, the expenditures for research instrumentation in cell biology/genetics increased 173 percent since 1989, from \$15 million to \$41 million, following a decrease between 1983 and 1986; in physiology/biophysics the increase in expenditures between 1989 and 1993 was 93 percent, following a slight decrease during the period 1986–89. Expenditures in pathology also increased from \$11 million to \$17 million during 1989–93, following a slight decrease during 1986–89.

The expenditures for biochemistry and “other, general biology” decreased during the period 1989–93, following a consistent increase between 1983 and 1989. During the period 1983–89, expenditures for research instruments in biochemistry increased, from \$19 million to \$50 million. However, this pattern changed in 1993, when expenditures declined to \$33 million, a 34 percent decrease. In the field of “other, general biology,” the expenditures increased from \$45 million in 1983 to \$127 million in 1989, and then decreased to \$115 million in 1993.

2.1.2. Expenditures by Type of Institution

Data for instrumentation expenditures were collected from biological science units at medical schools and at non-medical colleges and universities. The pattern for instrumentation expenditures differed based on the type of institution. Expenditures for medical schools increased at a steady pace during the period 1983–93 from \$79 million to \$175 million. Expenditures at universities and colleges, however, declined between 1989 and 1993, the first time since the survey began that biological units have shown a decline.

During the period 1989–93, expenditures for the purchase of biological research instrumentation at all medical schools increased by 28 percent. Expenditures of both public and private medical schools increased during this period. The increase for private medical schools between 1989 and 1993 was the largest recorded during the four cycles of this survey: \$26 million, an increase of 66 percent. (Table 1)

Expenditures for the purchase of biological research instrumentation at colleges and universities had a different pattern in recent years. Total expenditures increased between 1983 (\$51 million) and 1989 (\$119 million) but then declined by 9 percent, from \$119 million in 1989 to \$108 million in 1993. Expenditures at private colleges and universities declined by 34 percent, from \$35 million in 1989 to \$23 million in 1993; expenditures at public colleges and universities were almost unchanged during this same period (\$84 million in 1989, \$85 million in 1993).

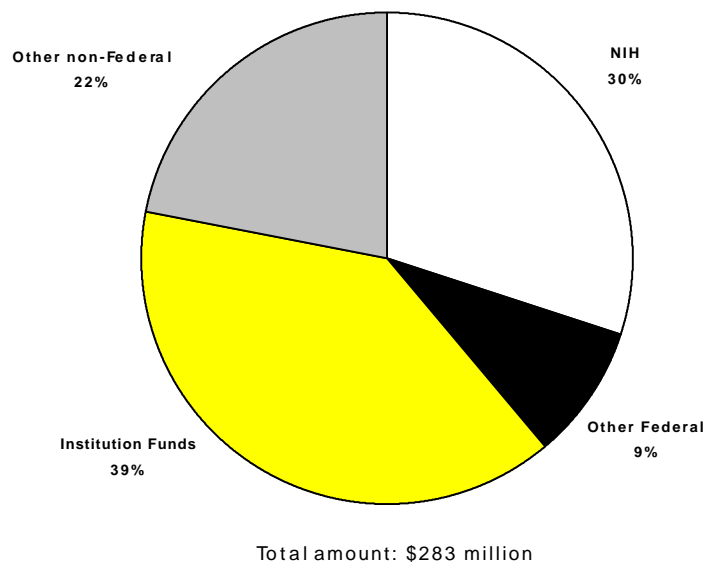
2.2. Sources of Funds

2.2.1. Federal Sources

In 1993 the Federal government provided \$110 million of the \$283 million total expenditures for the purchase of academic research instrumentation in the biological sciences—39 percent of all funds expended. (Table A-1) The percentage of funds provided by the Federal government to the biological sciences for the purchase of instrumentation declined between 1983 and 1993: the Federal government provided 48 percent in 1983, 54 percent in 1986, and 39 percent in 1993. These data were not collected in 1989.

NIH was the single largest Federal contributor to the purchase of research instrumentation in the biological sciences in 1993. Of the \$283 million expended for the purchase of biological science research instrumentation, NIH contributed \$85 million, or 30 percent of the total. (Figure 1) NSF was the second largest Federal source of funds, contributing \$18 million or 6 percent of the total. (Table A-1)

Figure 1. Source of funds for the purchase of academic research instruments in the biological sciences: 1993



SOURCE: Academic Research Instruments and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

2.2.2. Non-Federal Sources

Non-Federal sources provided the majority of funds for the purchase of research instrumentation in the biological sciences in 1993 (61 percent). Among both Federal and non-Federal sources, the institutions themselves contributed the largest amount of funds, \$111 million, or 39 percent of the \$283 million that was spent in 1993 to purchase research instrumentation. (Table A-1)¹⁶

“Other” non-Federal sources (private nonprofit foundations, gifts/donations, and bonds) were the second largest non-Federal source of funds for the purchase of academic research instrumentation in the biological sciences. They provided \$33 million dollars or 12 percent of the total in 1993.

The third largest source of non-Federal funds for the purchase of academic research instrumentation was grants and appropriations from State governments. State governments provided \$16 million or 6 percent of the \$283 million spent for the purchase of academic research instrumentation in 1993.

Finally, industry funds were the fourth largest source of non-Federal funds for the purchase of academic research instrumentation. They provided \$14 million or 5 percent of the total funds in 1993.

2.3. Expenditures for Maintenance/Repair and Operation of Academic Research Instrumentation

2.3.1. Total Expenditures

The cost to purchase a research instrument was only one part of the total resources required to use the instrument for its intended purpose; there was also a significant amount of resources required to maintain, repair, and operate the instrument. In 1993, the total expenditures for the maintenance/repair and operation of the current stock of academic research instruments used in the biological sciences were \$192 million or 68 percent of the expenditures for the purchase of new research instrumentation in the biological sciences.

The single largest cost was for the operation of the biological science research instruments, \$137 million, or 48 percent of the sum spent to purchase biological science research instruments in 1993. The cost to maintain and repair the biological research instrumentation was \$55 million in 1993, or 19 percent of the cost to purchase biological science research instruments. (Table 2)

¹⁶ Institutional instrumentation expenditures generally come from one of four sources: indirect cost recovery from awards from the Federal government and other sources; State operating appropriations from general revenues; student tuition; and unrestricted gifts and income (e.g., endowments).

2.3.1.1. Expenditures by Field of Biological Science

Expenditures for maintenance/repair and operation of academic research instrumentation varied by field of biological science. General biological sciences had the largest amount of expenditures, \$63 million, for total maintenance/repair and operation of instrumentation, followed by biochemistry (\$43 million) and cell biology/genetics (\$37 million). The least amount of expenditures was in pathology and pharmacology, each at \$8 million.

Expenditures for maintenance/repair and operation as a percentage of expenditures to purchase research instruments also varied considerably. Biochemistry expended more to maintain/repair and operate research instruments in 1993 than to purchase new instruments; maintenance/repair and operation costs were 129 percent of purchase costs. In contrast, maintenance/repair and operation costs in microbiology and pathology were slightly less than half of the cost to purchase research instruments for these fields. (Table 2)

2.3.1.2. Expenditures by Type of Institution

Medical schools spent \$112 million on maintenance/repair and operation of existing academic research instrumentation; these expenditures were the equivalent of 64 percent of their total 1993 expenditures for the purchase of research instruments. Of the \$112 million, \$82 million were spent by public institutions and \$29 million by private institutions.

Non-medical colleges' and universities' expenditures were \$81 million, the equivalent of 75 percent of their total expenditures for the purchase of research instruments. Private non-medical colleges and universities' expenditures for maintenance/repair and operation were almost twice as much as expenditures to purchase new research instrumentation for biology units (167 percent). By comparison, the maintenance/repair expenditures at public colleges and universities were 49 percent of their expenditures to purchase new research instrumentation for biology units.

Table 2. Total cost of maintenance/repair, and operation of existing academic research instrumentation, and those costs as a percent of expenditures for the purchase/acquisition of new scientific research instrumentation in the biological sciences, by field of biological science, type of institution, and institutional control: 1993

[Dollars in millions]

Field of biological science, type of institution, and institutional control	Total maintenance/repair and operation		Type of cost			
	Dollars	Percent	Maintenance/repair		Operation	
			Dollars	Percent	Dollars	Percent
All biological sciences.....	192	68	55	19	137	48
Research field:						
Biochemistry	43	129	8	23	35	105
Cell biology/genetics	37	89	8	19	29	70
Microbiology.....	18	46	8	20	10	26
Pathology.....	8	49	4	23	4	26
Pharmacology.....	8	80	2	17	7	64
Physiology/biophysics.....	15	57	3	13	12	45
Other biology, general.....	63	55	23	20	40	35
Type of institution:						
Medical schools, total	112	64	31	17	81	46
Public	82	75	20	19	62	56
Private	29	45	10	16	19	30
Colleges and universities, total	81	75	25	23	56	52
Public	42	49	15	18	26	31
Private	39	167	9	39	30	128

NOTE: Because of rounding, details may not add to totals.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

2.3.1.3. Maintenance/Repair

Expenditures for maintenance/repair included service contracts and field service, salaries for maintenance personnel, and other costs such as tools and supplies. The total expenditures in 1993 to maintain and repair existing research instrumentation in the biological sciences were \$55 million.

Maintenance/repair expenditures for research instrumentation varied by field of science. Biochemistry, cell biology/genetics, and microbiology each spent \$8 million on maintenance/repair, while pathology and physiology spent \$4 million and \$3 million, respectively. By far, the greatest expenditures for maintenance and repair were in “other, general biology” (\$23 million).

The patterns of expenditures for maintenance and repair were similar for biological science units at both medical schools and colleges and universities. Biological science units at medical schools spent \$31 million in 1993 for the maintenance and repair of their research instruments, the equivalent of 17 percent of their expenditures to purchase research instruments. Biological

science units at colleges and universities spent \$25 million for maintenance and repair, the equivalent of 23 percent of their expenditures to purchase research instruments. (Table 2)

2.3.1.4. Operation

The total expenditures in 1993 to operate research instrumentation in the biological sciences were \$137 million, the equivalent of 48 percent of the expenditures for the purchase of research instrumentation. (Table 2)

The pattern of a large ratio of expenditures for the maintenance and repair of biological research instruments by private non-medical colleges and universities continued for the operation of these instruments. As shown in Table 2, these biological science units spent \$30 million to operate their research instruments. This was three times the amount spent to maintain and repair such instruments in 1993 (\$9 million) and 28 percent more than the amount spent to purchase new research instruments (\$23 million). (Table 1)

2.3.2. Adequacy of Research Instruments' Maintenance/Repair

Department chairs and heads of facilities in biological sciences were asked to rate the adequacy of the maintenance/repair of research equipment in their units. To make this assessment, they were given a five-point scale that ranged from excellent (scale point 1) to poor (scale point 5). The mean rating of all respondents was 2.9.

The modal response (47 percent) was that the maintenance/repair of instrumentation was adequate. In addition, 30 percent of the respondents reported that maintenance/repair was above adequate to excellent. On the other hand, 19 percent of the respondents reported that maintenance/repair was inadequate, and 3 percent reported that maintenance/repair was poor. (Table A-2)

Respondents' perception of the adequacy of maintenance/repair of instruments varied by research field. For example, in the subfield of microbiology, the majority of the respondents reported satisfaction with the adequacy of maintenance/repair; 35 percent reported it as adequate, 34 percent reported it as above adequate, and 16 percent reported it as excellent. Only 15 percent reported maintenance/repair as less than adequate.

Respondents in the subfield of biochemistry were bipolar in their assessment of adequacy for that category. Twenty-three percent of the respondents reported the maintenance/repair of instruments as poor, the highest response of any field. An additional 13 percent reported it to be below adequate. On the other hand, 41 percent rated their maintenance/repair as above adequate to excellent. Only 23 percent rated it as adequate, the smallest percentage of response for that category.

Respondents in colleges and universities tended to rate the adequacy of maintenance/repair on their current research instruments slightly higher than did the respondents in medical schools. The

mean rating of respondents in colleges and universities was 3.1. This was higher than that given by the respondents from medical colleges (mean rating of 2.7) and by the respondents for biological sciences as a whole (mean rating of 2.9).

2.3.3. Availability of Resources to Operate Equipment

Department chairs and heads of facilities in the biological sciences were asked to rate the availability of resources to operate current equipment in their units on a scale of 1 (excellent) to 5 (poor). The mean response was 3.3. Fifty percent indicated that the availability of the resources to operate equipment was adequate. Twelve percent reported that the availability of resources was above adequate to excellent, and 37 percent reported that it was inadequate. (Table A-10)

By research field, the respondents in the subfield of microbiology rated the availability of their resources highly. Specifically, 20 percent of the department chairs in microbiology reported that the availability of their resources to operate equipment was excellent, 12 percent reported it to be above adequate, and 51 percent reported it to be adequate. On the other hand, 51 percent of the respondents in biochemistry reported that the availability of their resources to operate equipment was inadequate, 41 percent reported it to be adequate, and 8 percent reported it to be above adequate. No respondent from biochemistry rated the availability as excellent.

Respondents in colleges and universities tended to rate the availability of resources to operate current research instruments somewhat lower than did respondents in medical schools. The mean rating of respondents in colleges and universities was 3.4. This was not a good a rating as that given by the respondents from medical colleges (mean rating of 3.1) and by the respondents for biological sciences as a whole (mean rating of 3.3).

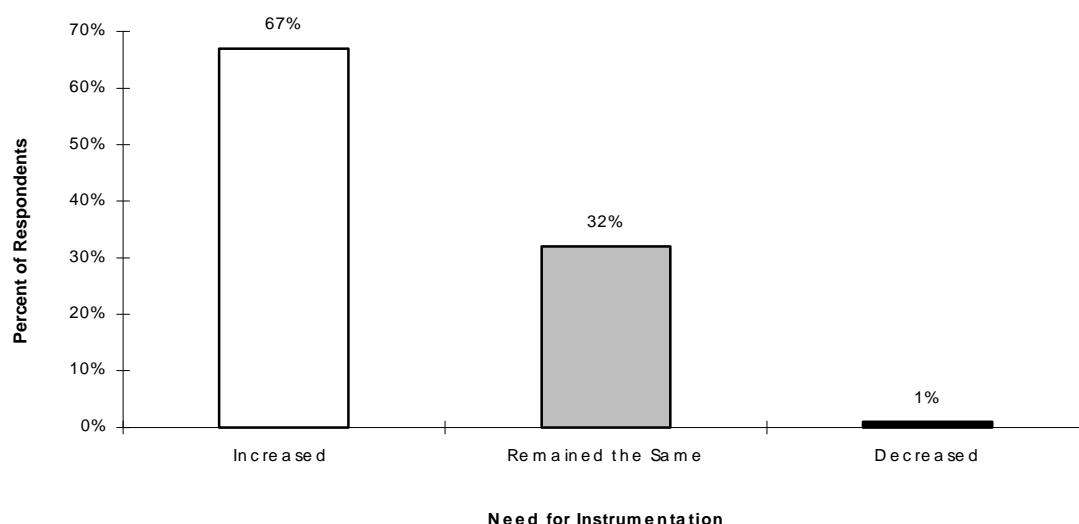
2.4. Capability, Needs, Amount, and Adequacy of Academic Scientific Research Instrumentation

The biological science department chairs and heads of facilities in medical schools and non-medical colleges and universities were asked to assess the current stock of academic research instruments available to their researchers. This assessment included the perceived needs for research equipment in their department or facility and the extent of their most pressing needs for instrumentation.

2.4.1. Changes in Needs for Research Instruments

Department chairs and heads of facilities were asked to assess the changes over the past 2 years (1992–94) in needs in their units for research instrumentation. To make this assessment, they were given a five-point scale that ranged from substantially increased (scale point 1) to substantially decreased (scale point 5). The mean rating for all respondents was 2.1. As shown in Figure 2 and Table A-3, 67 percent reported that their unit's need for research equipment had increased. One percent reported that it had decreased; 32 percent reported that instrument needs had remained the same.

Figure 2. Assessment of the need for research instrumentation in the biological sciences: 1992 - 1994



SOURCE: Academic Research Instruments and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

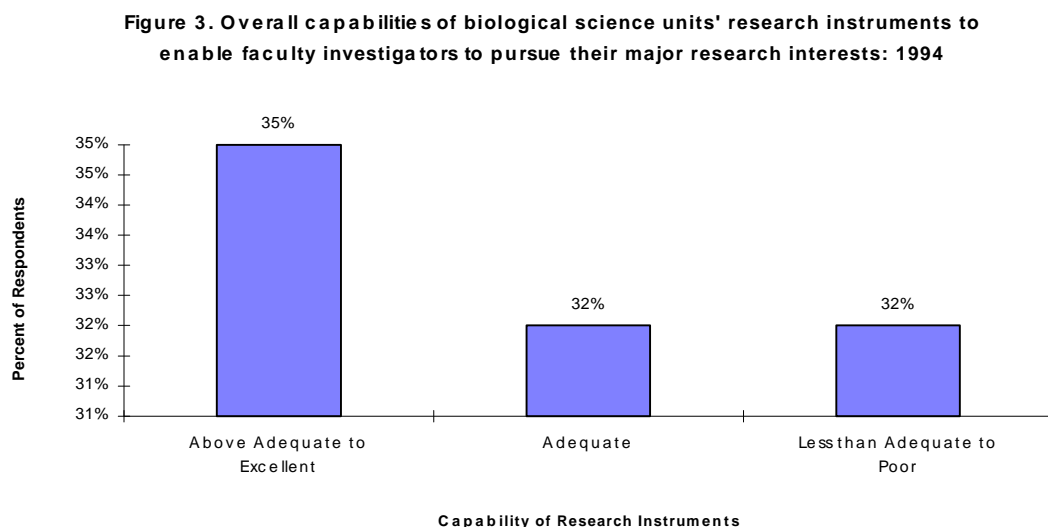
Among the various fields in the biological sciences, the respondents in the subfields of cell biology/genetics and physiology/biophysics reported the greatest increase in need for research instruments in the period 1992–94. In cell biology/genetics, 90 percent of the respondents reported that their instrument needs had increased; in physiology/biophysics, 77 percent of

respondents reported that their instrument needs had increased. The mean rating for respondents in cell biology/genetics was 1.9; in physiology/biophysics it was 1.7. (Table A-3)

Overall, the perceptions of respondents in medical schools and non-medical colleges and universities were quite similar. Their mean ratings were 2.1 and 2.2, respectively. Specifically, 66 percent of the respondents in medical schools and 69 percent of the respondents in non-medical colleges and universities reported that their needs for research equipment had increased between 1992 and 1994.

2.4.2. Capability of Academic Research Instruments

Department chairs and heads of facilities in the biological sciences were asked to assess the research instrumentation in their units in terms of its capability to enable faculty investigators to pursue their major research interests. To make this assessment, they were given a five-point scale that ranged from excellent (scale point 1) to poor (scale point 5). The overall mean rating was 2.9. (Table 3) Thirty-five percent of respondents rated their research instruments as adequate for this purpose, 32 percent rated their research instruments as less than adequate to poor, and 32 percent rated their research instruments as above adequate to excellent. (Figure 3)



SOURCE: Academic Research Instruments and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

The assessment of instrumentation capability varied considerably by subfield. For instance, only 3 percent of the respondents in microbiology gave a less than adequate rating to the capability of their research instruments to enable investigators to pursue their research interests. At the same time, 20 percent rated their research instruments as excellent, another 20 percent rated them as above adequate, and 57 percent rated their instruments as adequate to meet the needs of their researchers.

However, respondents in physiology/biophysics were less positive. A majority (52 percent) reported that the capability of their research instruments was less than adequate, and no respondent reported the capability of the instruments as excellent. The mean rating was 3.4.

Respondents in medical schools were more likely than respondents in non-medical colleges and universities to rate the capability of their research instruments as above adequate to excellent: 41 percent for respondents in medical schools and 24 percent for respondents in non-medical colleges and universities. However, the mean rating of respondents in medical schools was 2.8; the mean rating of respondents in non-medical colleges and universities was 3.0. (Table 3)

Table 3. Percentage distribution of capability of academic research instruments to enable existing faculty investigators to pursue their major research interests, by field of biological science, type of institution, and institutional control: 1994

[Percentage]

Field of biological science, type of institution, and institutional control	Capability of instruments to enable research					
	Excellent (1)	(2)	Adequate (3)	(4)	Poor (5)	Mean rating ¹
All biological sciences.....	8	24	35	32	+	2.9
Research field:						
Biochemistry.....	9	31	10	50	0	3.0
Cell biology/genetics.....	8	31	44	18	0	2.7
Microbiology.....	20	20	57	3	0	2.4
Pathology.....	*	*	*	*	*	*
Pharmacology.....	*	*	*	*	*	*
Physiology/biophysics.....	0	10	38	52	0	3.4
Other biology, general.....	8	24	31	36	+	3.0
Type of institution:						
Medical schools, total	9	32	27	32	0	2.8
Public	7	29	30	34	0	2.9
Private	15	45	15	25	0	2.5
Colleges and universities, total	8	16	43	32	+	3.0
Public	9	14	46	31	1	3.0
Private	5	23	36	36	0	3.0

¹ Capability of research instruments was rated on a scale of 1 (excellent) to 5 (poor).

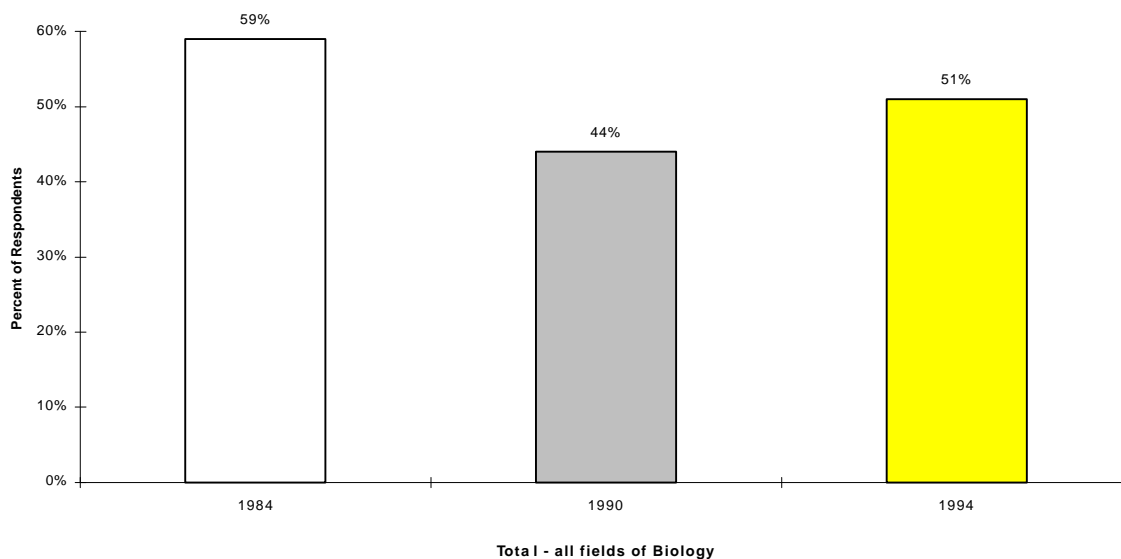
NOTE: Because of rounding, percentages may not add to 100.

KEY: + = less than 0.5 percent
* = insufficient number of cases for analysis

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

Respondents were also asked to indicate whether there were any important subject areas in which investigators in their unit were unable to perform critical experiments in their areas of research interest due to lack of needed equipment. This assessment has changed over the years. It improved between the 1984 and 1990 surveys, but worsened by the 1994 survey. In 1984, 59 percent of the respondents reported that there were subject areas in which investigators were unable to perform critical experiments; in 1990, the percentage dropped to 44 percent. By 1994, however, the percentage increased again, with 51 percent of the respondents reporting this problem. (Figure 4)

Figure 4. Percent of respondents reporting that their investigators cannot do critical experiments in their area of research, due to lack of needed instrumentation: 1984 - 1994



NOTE: No data are available for 1987.

SOURCE: Academic Research Instruments and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

2.4.3. High-Priority Instrumentation

Department chairs and heads of facilities in the biological sciences were asked to identify the three research instruments with a purchase price of \$20,000 or more that were most needed to bring the research equipment up to their faculty's full capabilities in their units. They were asked to list these items in priority order, to estimate the purchase price for each, and to state the reason they were needed. In the following analysis, we distinguish between the perceived needs for all of the top-three research instruments and the perceived need for the highest-priority research instrument.

Twelve percent of the respondents replied that they did not need any research instruments with a purchase price of \$20,000 or more. With the substantial decrease in the purchase price of desktop computers and workstations, this response was not unexpected. The following analysis is based upon the remaining 88 percent of the respondents who did express a need for a research instrument with a purchase price of \$20,000 or more.

2.4.3.1. Total Estimated Purchase Price of High-Priority Items

The total cost to purchase all of the three top-priority research instruments mentioned by the respondents was \$363 million. (Table 4) Of this total, \$163 million (45 percent) would be required to purchase the first-priority research instrument.

Table 4. Total cost for the first priority item requested and total cost for the top three priority items requested in the biological sciences, by field of biological science, type of institution, and institutional control: 1994

[Dollars in millions]

Field of biological science, type of institution, and institutional control	Total cost	
	First priority item	Top three priority items
All biological sciences	163	363
Research field:		
Biochemistry	66	125
Cell biology/genetics	8	28
Microbiology	10	22
Pathology	5	13
Pharmacology	5	12
Physiology/biophysics	18	32
Other biology, general	52	131
Type of institution:		
Medical schools, total	64	174
Public	46	125
Private	19	50
Colleges and universities, total	99	189
Public	59	123
Private	40	66

NOTE: Because of rounding, details may not add to totals.

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

2.4.3.2. Need by Type of Instrument

Chromatographs and spectrometers. In terms of total purchase price for the three top-priority research instruments, the greatest need was for chromatographs and spectrometers (including electron spectrometers, mass spectrometers, and nuclear magnetic resonance spectrometers). The total estimated purchase price was \$137 million, or 38 percent of the total purchase price for all three top-priority instruments. The perceived need for chromatographs and spectrometers was greatest in biochemistry, where respondents requested chromatographs and spectrometers with a total purchase price of \$101 million. (Table A-6)

The total cost to acquire chromatographs and spectrometers listed as highest-priority research instruments was approximately \$62 million. (Table A-5) Overall, 14 percent of all respondents identified chromatographs and spectrometers as their highest priority. (Table A-7) Again the

subfield in which the perceived need for chromatographs and spectrometers was greatest was biochemistry (\$54 million or 86 percent of the total requested for these research instruments). (Table A-5)

The median¹⁷ cost of all chromatographs and spectrometers listed as the highest priority was \$200,000. (Table A-7) This was greater than twice the median cost of all first-priority research instruments (\$80,000). The median cost of the chromatographs and spectrometers requested by medical schools was \$280,000, the highest median cost of any type of first-priority research instrument requested. By contrast, the median cost of the chromatographs and spectrometers requested by respondents in colleges and universities was \$77,500.

Bioanalytical instruments. Bioanalytical research instruments include cell sorters, centrifuges, DNA analyzers, and scintillation detectors. The total estimated cost to purchase all three top-priority bioanalytical research instruments was \$96 million, the second highest total estimated purchase price. (Table A-6) This was 27 percent of the total amount for all three top-priority research instruments. The subfield with the greatest perceived need as measured by total estimated purchase price, was “other biological sciences,” with an estimated purchase price of \$34 million.

Bioanalytical instruments were identified as the first-priority research instrument by the largest percentage of respondents, 40 percent. (Table A-7) The total estimated purchase price for all highest-priority bioanalytical research instruments was \$36 million. (Table A-5) The estimated median purchase price for these instruments was \$60,000. (Table A-7) The subfield with the highest total estimated purchase price for highest-priority bioanalytical instruments was biochemistry (\$10 million). (Table A-5)

Microscopes. Microscopy instruments, which included electron microscopes, had the third-highest total estimated purchase price. The total estimated price to purchase all the microscopy instruments listed in the three top-priority research instruments was \$59 million, or 16 percent of the total for all top-priority research instruments. Of that, \$36 million was in “other biological sciences,” \$9 million was requested in cell biology/genetics, and \$7 million was in physiology/biophysics. (Table A-6) Also 32 percent of the purchase price for the top-three research instruments in pathology was for microscopes; in cell biology/genetics, 31 percent of the purchase price for the top-three research instruments was for microscopes. The total cost to purchase microscopes listed as highest-priority research instruments was \$36 million. (Table A-5) Overall, 19 percent of all respondents identified microscopes as their highest-priority research instrument (Table A-7). The subfield with the largest overall estimated purchase price for highest-priority microscopes (\$24 million) was “other biological sciences” (out of the \$36 million necessary to purchase all highest-priority microscopes, Table A-5). The median estimated purchase price for the highest-priority microscopes was \$150,000. (Table A-7)

¹⁷ Median was used instead of mean since it reduced the effect of observations with extreme values.

Computers. The total estimated cost to purchase all three top-priority computers was \$34 million (Table A-6), or 9 percent of the total for all high-priority research instruments. Of this amount, \$18 million was requested by respondents in “other biological sciences.” The subfield with the highest proportionate need was pathology: 32 percent of the reported need for three top-priority instrumentation was for computers.

The total cost to purchase all highest-priority computers was \$15 million. (Table A-5) Overall, 14 percent of the respondents identified computers as their highest-priority research instrument. (Table A-7) The median cost of these highest-priority computers was \$60,000—along with bioanalytical instruments—the two least expensive of the five general types of research instruments.

Other research instruments. This category was used to describe a group of heterogeneous research instruments in which no single type was large enough to constitute an independent category. They included cameras, lasers, and temperature control instruments. The total estimated purchase price for all three top-priority instruments in this category was \$37 million or 10 percent of the total. (Table A-6) The total estimated purchase price of “other research instruments” identified as first-priority by biological science respondents was \$13 million. (Table A-5) The median estimated purchase price of these instruments was \$90,000. (Table A-7)

For additional information regarding the distribution of the highest priority research instruments, consult Table A-8. This table presents the distribution of the cost to purchase the highest priority research instruments by type of institution (medical schools, colleges and universities) and by type of control (public, private). The same information is presented for the three top-priority research instruments in Table A-9.

2.4.3.3. Reason Instrument Needed

Respondents were asked to state why the research instrument was needed, choosing from among three reasons provided on the questionnaire: (1) replace an existing instrument; (2) expand capacity (more copies of existing equipment); and (3) upgrade capabilities (perform experiments that researchers cannot do now). Upgrading capabilities was reported by 44 percent of the respondents as the main reason for needing the first-priority research instrumentation. Expanding capacity was reported by 31 percent of the respondents as the reason, while replacing existing equipment was reported by 26 percent of the respondents.¹⁸

2.4.4. Optimal Price Range of Federal Funding

Respondents were asked to identify the price range of the research equipment that would be most beneficial to faculty members in their units. A slight majority (54 percent) expressed a preference for relatively inexpensive research instruments, those with a purchase price of less than \$50,000.

¹⁸ Unpublished NIH instrumentation survey data

For all respondents in the biological sciences, the modal response (32 percent) was for research instruments in the range of \$20,000–\$49,999. (Table 5)

This preference for less expensive research instruments was shared by respondents from both medical colleges and from colleges and universities: fifty-five percent of the respondents from colleges and universities said that research instruments with a purchase price of less than \$50,000 would be most beneficial; 52 percent of the respondents in medical colleges agreed with this appraisal.

The second most preferred price range for instrumentation identified by the respondents was for instruments costing \$100,000 to \$499,000; 25 percent of all respondents expressed a preference for instruments in this price range. It also was the modal response for respondents from private colleges and universities (42 percent), cell biology/genetics (39 percent), biochemistry (37 percent), and public medical schools (30 percent).

Few respondents expressed a preference for very expensive research instruments. Only 2 percent of all respondents said that research instruments with a purchase price of \$500,000 or more would be most beneficial. These respondents were concentrated in two fields of science: cell biology/genetics (10 percent) and biochemistry (4 percent).

Table 5. Percentage distribution of the price range of instruments for which increased Federal instrumentation funding would be most beneficial to biological science units, by field of biological science, type of institution, and institutional control: 1994

[Percentage]

Field of biological science, type of institution, and institutional control	Price range most beneficial						
	Under \$10,000	\$10,000-\$19,999	\$20,000-\$49,999	\$50,000-\$99,999	\$100,000-\$499,999	\$500,000-\$999,999	\$1,000,000 and over
All biological sciences.....	1	21	32	20	25	1	1
Research field:							
Biochemistry.....	0	12	27	19	37	3	1
Cell biology/genetics.....	0	8	23	19	39	10	0
Microbiology.....	0	41	28	8	24	0	0
Pathology.....	*	*	*	*	*	*	*
Pharmacology.....	*	*	*	*	*	*	*
Physiology/biophysics.....	0	16	37	26	21	0	0
Other biology, general.....	1	23	29	24	22	+	+
Type of institution:							
Medical schools, total.....	1	21	30	19	27	1	1
Public.....	1	25	27	17	30	0	1
Private.....	0	4	40	29	18	7	2
Colleges and universities, total.....	+	21	34	22	22	1	+
Public.....	1	23	38	21	16	1	+
Private.....	0	13	21	24	42	0	0

NOTE: Because of rounding, percentages may not add to 100.

KEY: + = less than 0.5 percent
* = insufficient number of cases for analysis

SOURCE: Academic Research Instrumentation and Instrumentation Needs in the Biological Sciences, National Institutes of Health: 1994

